Signed Languages, Verbal languages, Coverbal Gestures: Analysis and Representation

Proposal of A New Line of Investigation for ILIKS

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The proposal, in a nutshell

The general idea is to broaden the investigation of Topics that are currently of interest within the ILIKS Area 4 (*Interaction and Communication*) through new studies focused on:

- signed languages (SL)
  - i.e. the visual-gestural languages used by deaf individuals, and within deaf communities of different size.
- coverbal gesturing in hearing people
  - with special reference to children and the role of gesture in language learning process
- the construction of the lexicon in early childhood
- child-adult communicative and linguistic interaction

The subtopics we are proposing, however, spread also over Area 5 (*Lexicon, ontologies, semantic interoperability and information extraction*).

Rationale of the proposal (I)

- Since the **modern study of SL** began, with Stokoe's (1960) pioneering study of American Sign Language (ASL), research on SL **has greatly enhanced our understanding of human language and its roots in human cognition, brain architecture, and socio-cultural organization.**
- Important progresses have also been made, especially in the last two decades (see McNeill, 1992; 2000, 2005; Kendon, 2004 for comprehensive overviews), in the study of **coverbal gesture that typically accompanies the production of speech in the prototypical, face-to-face condition** (as opposed to the very different situation determined by a written encoding of language which, is worth recalling and underscoring, is proper of a very small minority of human language systems – see Ong, 1986).
- Several members of the Italian team that would be involved in the research we propose have significantly contributed in **research highlighting the crucial role that visual-manual gestures play in language learning processes** (e.g. Volterra & al, 2005; Capirci et al, 1996; Caselli & Casadio, 1995, Pizzuto & Capobianco, 2005, among others). Relevant work in this area has also been recently undertaken, with **very promising preliminary results, using ontological constructs and methodologies for the analysis of** (especially coverbal) **gestures** (Catenacci & al, 2006).

Rationale of the proposal (II)

- In the past as at present **most studies of SL have aimed to demonstrate that**, in spite of the substantial differences in the modality of language expression (visual-gestural vs. the acoustic-vocal modality proper of speech), **the underlying structure of SL is essentially comparable to that of spoken or verbal (vl)**, most notably with respect to the arbitrary symbolic relations that govern form-meaning correspondences, at different levels of organization of language systems (e.g. phonology, morphology, the lexicon, syntax etc).

- **This "assimilationist" view, however, has been convincingly challenged** on the grounds of research conducted primarily on French Sign Language (LSF) **by Cuxac** (1996; 2000; 2003; see also Jouison, 1986; 1995) and several (more or less younger) scholars working in the framework proposed by Cuxac (e.g. Sallandre, 2003; Cuxac & Sallandre, 2004 & to appear; Fusellier, 2004 & to appear).

Rationale of the proposal (III)

- Drawing on detailed analyses of SL's lexical-morphological structure as it emerges from ***discourse***, it has been clearly demonstrated that **SL possess modality-specific structural features which**, on one hand, demand to be taken fully into account and, on the other hand, **appear to provide most valuable cues for a clearer understanding (and description) of human language faculty**, its underlying cognitive substrate, its roots in human socio-cultural organization.

- These features of SL - largely ignored or underestimated in most past and current research on SL – become visible taking in due account **highly iconic structures (HIS)** that are extensively used in SL discourse (see later), **the multilinear - multimodal packaging of the linguistic message** that results from the fact that in SL, unlike in vocal languages, the articulators (eye-gaze, face, hands, postures of the body or portions of the body) are structured in the three dimensions of space, as well as in time. In SL one also finds **a uniquely structured use of eye gaze for marking and conveying both *linguistic* and *metalinguistic* information**.

Rationale of the proposal (IV)

- The lines of research we propose crucially refer to this theoretical and methodological framework for SL research, and its fruitful application in crosslinguistic and crosscultural research we have undertaken, within the context of an ongoing (2004-2007) bilateral CNR-CNRS project (Pizzuto & Cuxac, 2004), on Italian (LIS), French (LSF) and also American (ASL) SL
  - See e.g. Cuxac & Pizzuto, 2006; Wilkinson, Sallandre, Rossini & Pizzuto, 2006.

- We have also reasons to believe that the insights that can be gained from this theoretical framework as employed in SL research can be most valuable for pursuing new analyses of coverbal gestures in children's early language development.

Rationale of the proposal (V)

- In spite of the remarkable progresses made, research on both SL and coverbal gesture still is confronted with a major methodological but also theoretical problem which, unfortunately, has received thus far much less attention than it deserves: **there are no appropriate tools for representing the forms of the gestures, hence also for exploring adequately form-meaning correspondences, modeling, etc**.
  - See Pizzuto, Rossini & Russo, 2006/LREC, for an overview of the issues at stake
- The construction of **appropriate reference corpora** is thus severely limited, as are the analyses one can perform.
- On the basis of ongoing work we are developing, **experimenting different forms of written representation for SL**, we believe that the collaborative research we envisage can significantly contribute to face and, hopefully, solve this problem, at least with respect to the needs of scientific investigation of SL and coverbal gesture.

Subtopics: list (I)

There are several subtopics we aim to address. Here we present six:

1. Linguistic and ontological analysis and representation of signed languages and coverbal gestures
2. SL as analyzers of human communication and language
3. Modeling signed language processing from both the Producer and the Receiver perspective (from a discourse perspective)

Subtopics: list (II)

4. Analysis and modeling of both continuities and differences between actions, gestures and (linguistic) signs

5. The construction of the lexicon in infancy and early childhood (taking into account vocal, gestural and multimodal behaviors)

6. Child-adult interaction: communication strategies and modalities

Summing up (I)

The subtopics we propose could also be conceived and described as integrations/expansions of ILIKS major topic areas (4) and (5) in the direction of:

the view from signed languages, gesture, coverbal gesture, language development and use in children and adults (most notably from a discourse perspective).

Summing up (II)

- The ultimate goal of our research is to define appropriate, discourse- and text-based methodologies for a clearer understanding, description and modeling of the face-to-face communicative and linguistic behaviors we plan to examine.

- Towards this end we will rely on inter- and trans-disciplinary knowledge and expertise (distributed among the team members to be involved in the research) in the fields of image analysis and treatment, linguistics, applied ontology, as well as developmental psychology and psycholinguistics.

Links with neurophysiology

- Relevant links with leading scholars in the fields of neurophysiology and brain imaging-based analyses of meaningful action and communicative behaviors may also be exploited as needed, most notably with reference to ongoing collaborations between members of the Italian team and Rizzolatti's laboratory.

  The framework arising from the discovery of **mirror neurons**, and their relevance for a clearer understanding of the relations between actions and representations, appears in fact to be potentially very promising for, and compatible with, the general approach to the study of communication and language shared by the researchers implicated in the research line we are proposing.

Crosslinguistic and crosscultural perspective

Investigations will be jointly developed in France and Italy, with a primary but by no means exclusive focus on French (LSF) and Italian (LIS) signed languages, including comparisons with both verbal languages (and coverbal gesture, especially in children's production), and other signed languages in addition to LSF and LIS.

Subtopic 1 (I)

Within the limits of this presentation, we will introduce only subtopic 1 and the ideas linked to it:

Linguistic and ontological analysis and representation of signed languages and coverbal gestures

Exploration of this subtopic is crucial due to the following reasons:

- an appropriate analysis and encoding of the communicative and linguistic behaviours we plan to study across subtopics is a necessary, preliminary step
  - it is also one of the necessary 'ingredients' for describing them appropriately, and also for testing the adequacy of different descriptions and models that can be developed for all purposes of scientific investigation (e.g. for comparing models based on linguistic an ontological description with models based on image analysis and recognition);

Subtopic 1 (II)

- the notation tools that are currently most widely used for representing and coding SLs, and more generally visual-gestural productions of any kind (hence also coverbal gestures as used by hearing children and adults), are severely limited;

- As a result, in most if not all research on SL (and gestures in general) gestural forms are “represented” only through verbal languages ‘labels’ which render only the basic meaning (or what is assumed to be the basic meaning) of the gestural forms examined. These labels, inappropriately called “glosses”, inevitably misrepresent the structures one aims to examine (see Pizzuto & al, 2006);

  - …new notation tools, along with new analyses, are sorely needed!

Examples

Two illustrative examples of:

- SL behaviors to be analyzed, represented, and modeled
- the problems researchers currently face due (also) to the absence of appropriate representation tools…

Example (1)

1 – a complex gestural unit from LIS (Italian Sign Language) discourse

the parameters constituted by:

-signer's gaze,

-facial expression,

-body posture,

-arms and hands configuration, positioning and movement

are all relevant, each contributing in a specific, well defined manner, to specify aspects of the complex meaning simultaneously encoded: « **the-boy-holds-the-dog-while-the-dog-licks-the-boy-on-his-cheek** »

Example (2)

2 – a complex gestural sequence drawn from LIS discourse, with the same complex interplay of multiple, simultaneously structured articulatory parameters (notably in Clips n. 3-8) , conveying the complex information: « **the-dog-puts-his-head-in-the-jar's-neck-and-gets-stuck-in-it** » (& other information ignored for the present purposes).

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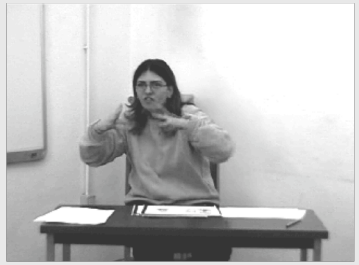

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Highly Iconic Structures (I)

- In most previous and even current SL research complex gestural units and sequences of the type just shown have been set aside as "gestural, non linguistic or paralinguistic behaviors, with continuous rather than discrete features".

- In contrast with this view, recent analyses of SL, most notably Cuxac's (2000) model of a Grammar of Iconicity and of a structured use of space grounded in discourse, highlight the **distinct linguistic features of structures of this kind**, formalized as **Highly Iconic Structures** (HIS) in Cuxac's model.

  - 'Iconicity' refers here to a 'morphism-preserving' representation, where morphisms are ultimately to be understood in terms of image-schemata (see Catenacci et al., 2006).

Highly Iconic Structures (II)

- Analyses of discourse structure in both French (LSF) and Italian (LIS) sl, recently extended to American Sign Language (ASL), have also demonstrated, across sl, the very high frequency of HIS (e.g. they may represent up to 70% or more of the constituent elements of a signed narrative text – Cuxac, 2000; Sallandre, 2003; Wilkinson & al, 2006).

- This framework has provided new perspectives in the study of SL structure: HIS appear to be based on modality specific cognitive-symbolic abilities whereby signers "iconize" their perceptual-practical experience, and make a structured use of the shared physical-linguistic space of signed discourse, (this is marked by specific gaze patterns, and visual and manual indexes used for referential purposes).

Coverbal gestures

- To an extent that remains to be ascertained, the representational abilities that characterize SL users are also undoubtedly displayed in coverbal gestures used by hearing children and adults. As highlighted by current research (e.g. **McNeill, 1992; 2000; 2005; Kendon, 2004),** coverbal gestures can and should be conceived as **an integral part of human language**, and their analysis and description can significantly enhance our understanding of the **cognitive and neurophysiological bases of human language faculty** in its prototypical manifestation, i.e. **in face-to-face interaction** (as opposed to the written modality).
  - A preliminary "gesture" ontology has been developed at LOA-Rome, and can be downloaded at

    http://www.loa-cnr.it/ontologies/Gesture.owl

The Representation Problem (I)

- In spite of the advancements that have been made in our current knowledge of the structure of sl and coverbal gesturing, **there are currently no adequate standardized written representation of the four-dimensional complex signals that compose "gestures"**, regardless of whether they occur in sl or in hearing persons coverbal gesturing.

- In fact, with one exception to be mentioned shortly, the **notation systems** that have been devised and are **currently used**, along with illustrative pictures and drawings, especially in the compilation of sl dictionaries, have severe limitations: they **can represent a limited set of individual signs**, (usually defined **"standard" signs**) but only as isolated, decontextualized items. The same notation tools **cannot be used to represent even a short sequence of signs linked in discourse**. Furthermore, these notation systems **cannot be used to encode HIS**. This is a most severe limitation since, as mentioned, HIS appear to constitute a most salient feature of signed discourse. Finally, these notation systems are very difficult to use, and have never evolved in any kind of 'writing' system that could be used by signers.

The Representation Problem (II)

- This state of affairs hampers further advancements in research not only on SLs, but also on verbal languages, especially (but not only) with respect to the gestural components of these latter:
  - appropriate **comparisons between sl and vl cannot be drawn if we do not have appropriate, comparable means for annotating** the behaviors that are of interest, and operating the necessary selection and classification on reasoned grounds
  - the relevant features that shape face-to-face human discourse and interaction cannot be adequately investigated because, in the absence of appropriate notation tools, **the distinction between what has to be considered linguistic, and what not, is drawn on relatively arbitrary grounds** rather than on an accurate analysis of the invariant vs. variable features of the communicative and linguistic productions under analysis

The Representation Problem (III)

- In order to understand the problems raised by the absence of appropriate written representations of the forms of SL it may be useful to consider the following. Imagine one wants to analyze and describe an unknown spoken language relying only on audio or even video-records of a more or less extensive corpus of such spoken language 'raw data', without any means for 'writing down' its forms, i.e. no International Phonetic Alphabet (IPA), no alphabetic or any other conventional writing system.

- It should be easy to see that, even with the help of the most skilled native speakers of that language, it would be extremely difficult, if not impossible, to pursue an appropriate analysis of the language to be described (e.g. parsing its utterances, identify the words and constituent sounds, etc). This is at present the situation with which SL researchers must confront themselves.

Relevant recent work and some hints on the research lines we would like to develop...

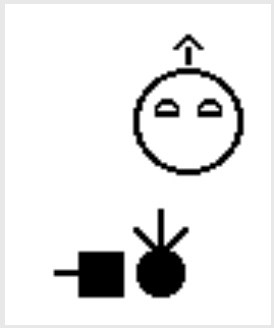
- Indications from the work developed in Rome, by a team of deaf and hearing researchers, experimenting whether “SignWriting” (SW) can be used to write LIS, and most notably to create and transcribe LIS texts.

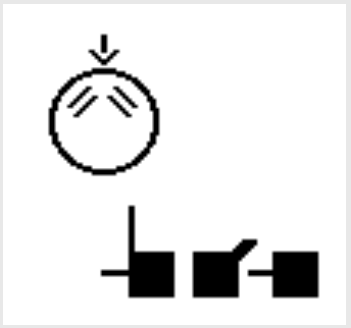
- Note: SW is a particular writing system that has been invented by Valerie Sutton (1998). Proposed as “an alphabet for SLs”, SW is built upon dance notation criteria and tools, and provides an extremely rich set of “graphemes” or “glyphs” that appear to be extremely easy to learn by deaf users (Di Renzo et al, 2006).

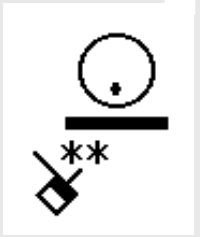
- Worth considering some examples of LIS texts (hand) written using SW.

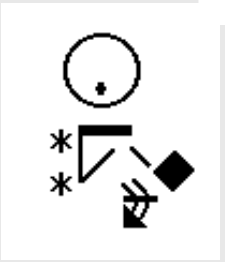
- Next slide: the title of a ppt presentation, encoding via SW glyphs the LIS written utterance meaning: “Is it possible to write and transcribe LIS with SW?”, and, on the right, the five names (in LIS) of the co-authors of the ppt presentation

SignWriting (SW)









To be read from top to down..

SignWriting (SW) (II)

- The important point to note is that this SW encoding (created by experienced signers competent in the use of SW) adequately represents the structure of the LIS utterance, with all its relevant manual and non manual components, the ordered sequence of the individual signs in time and space, and it does so in such a fashion that the LIS signers who know SW can easily reconstruct (and reproduce) the signed utterance intended.

- To our knowledge this result has never been achieved by other means of written representation, and certainly CANNOT be achieved via written labels drawing on spoken-language meanings and forms as are most commonly used to “represent” signs.

  - In English wording such a written/spoken representation of the LIS utterance would in fact be something like: “SW LIS WRITE TRANSCRIBE CAN?”, a representation which obviously does not permit to recover anything of the signed forms one aims to “represent”... with all the consequences this implies for the investigation of LIS and its form-meaning patterns.

Researchers involved (I)

ISTC-CNR:

Elena PIZZUTO, Olga CAPIRCI and M. Cristina CASELLI as representatives and coordinators of, respectively, the following ISTC Laboratories:

- Sign Language (www.istc.cnr.it/sll/),
- Gesture and Language (www.istc.cnr.it/gall/),
- Language Development and Disorders (www.istc.cnr.it/ladd/).

Virginia VOLTERRA as coordinator of the ISTC

- Neuropsychology of Language and Deafness Unit (www.istc.cnr.it/nls/).

Carola CATENACCI, Aldo GANGEMI, Domenico PISANELLI and Geri STEVE of the ISTC

- Laboratory for Applied Ontology (www.loa-cnr.it).

The type, amount and sequencing of each researcher's involvement will differ, and it will be specified at a later date. However, Elena Pizzuto, Olga Capirci, Carola Catenacci and Aldo Gangemi would be involved from the start in work exploring, from different perspectives, key issues implicated in developing appropriate ontological and linguistic analyses and representations of signed languages (specifically of Italian Sign Language or LIS), and gestures.

Researchers involved (II)

IRIT-UPS (Toulouse):

Patrice DALLE, and other colleagues and/or doctoral students of his team (to be specified subsequently).

CNRS-UMR 7023 (Université Paris 8):

Christian CUXAC, Brigitte GARCIA, Ivani FUSELLIER, Marie-Anne SALLANDRE, Dominique BOUTET and other French colleagues currently collaborating with Dalle in the development of appropriate linguistic representations and modeling of SLs (notably of French Sign Language, or LSF), and gestures.

It should be noted that ISTC-CNR and the CNRS-UMR 7023 are currently carrying out a Joint CNR/CNRS project on “Language, its formal properties and cognition: what can be learned from signed languages”. The resulting interdisciplinary collaboration would significantly enhance very promising lines of work that are already active, and generate new lines of investigation aimed at a clearer understanding of signed vs. spoken discourse and communicative interaction.

Ongoing Work and Projects

- Relevant results and indications stemming from the ongoing French Project "LS Script: experimenting SW with deaf children", work partially comparable (with equally positive results) to that developed by the Italian team, and including a broad investigation on writing and notation tools for SL and more generally gestural production
  - (part of this work is developed in the frame of the joint CNR-CNRS Project "Language, its formal properties and cognition: what can be learned from signed languages (2004-2007)
- Work done at IRIT, in close collaboration with the UMR 7023 CNRS Unit of Paris 8 (& Department of Language Sciences): modeling from different perspectives LSF (testing different types of linguistic analyses, using image analysis and recognition methodologies)
- CNR/CNRS Joint Project "Language, its formal properties and cognition: What can be learned from signed languages" (Coordinators: E. Pizzuto, ISTC-CNR & C. Cuxac, CNRS UMR 7023 & Univ. Paris 8, St.Denis, 2004-2007).
- Joint ISTC-CNR (SLL) & Rome Institute of the Deaf (ISSR) Project "Writing LIS and SignWriting" (2005 -)

Most directly relevant recent publications (I)

- Aznar, G., Dalle, P., Ballabriga, C. (2006). Analysis of the different methods to encode SignWriting in Unicode. In C. Vettori (ed.) *LREC 2006 - 2nd Workshop on the Representation and Processing of Sign Language: Lexicographic Matters and Didactic Scenarios*, Pisa, ILC/ Evaluations and Language resources Distribution Agency (ELDA), 59-63.
- Capirci,O., Contaldo, A., Caselli, M.C., Volterra, V. (2005). From Action to language through gesture: a longitudinal perspective. *Gesture*, 5, 1/2, 155-177.
- Catenacci, C., Capirci, O., Gangemi, A. (2006). Steps towards an ontology of gestures. To appear as Technical Report on htttp://www.loa-cnr.it. A preliminary “gesture” ontology can be downloaded at htttp://www.loa-cnr.it/ontologies/Gesture.owl
- Dalle, P. (2006) . High level models for sign language analysis by a vision system. In C. Vettori (ed.), *LREC 2006 - 2nd Workshop on the Representation and Processing of Sign Language: Lexicographic Matters and Didactic Scenarios*, Pisa, ILC/ Evaluations and Language resources Distribution Agency (ELDA), 17-20.

Most directly relevant recent publications (II)

- Dalle, P. Lenseigne, B. (2005)._Vision-based sign language processing using a predictive approach and linguistic knowledge. In *IAPR conference on Machine Vision Applications - MVA 2005*, *Tsukuba Science City, Japan*, *16/05/2005-18/05/2005*, The International Association for Pattern Recognition (IAPR), 510-513,
- Di Renzo, A., Lamano, L., Lucioli, T., Pennacchi, B., Ponzo, L., (2006), Italian Sign Language: Can we write it and transcribe it with Sign Writing ? In C. Vettori (ed.), *Proceedings of the Second Workshop on the Representation and Processing of Sign Languages, International Conference on Language Resources and Evaluation - LREC*, Genova, 28 maggio 2006. Pisa: ILC-CNR, 11-16.
- Pizzuto, E., Rossini, P. & Russo, T. (2006). Representing signed languages in written form: questions that need to be posed, in C. Vettori (ed.), *Proceedings of the Second Workshop on the Representation and Processing of Sign Languages, International Conference on Language Resources and Evaluation - LREC*, Genova, 28 maggio 2006. Pisa: ILC-CNR, 1-6.